

What is claimed is:

[c01] 1. A method for biaxially-texturing a surface-region of an amorphous material, comprising:

 depositing the amorphous material onto a substrate; and

 supplying active oxygen near the substrate during ion beam bombardment of the amorphous material to create an amorphous material having a biaxially textured surface,

 wherein the ion beam bombardment occurs at a predetermined oblique incident angle of about 0-45° between an ion beam and the surface of the amorphous material.

[c02] 2. The method of claim 1, wherein the active oxygen comprises at least one of: atomic oxygen, oxygen ion, and ozone.

[c03] 3. The method of claim 1, wherein the active oxygen is a component of the ion beam.

[c04] 4. The method of claim 1, wherein the active oxygen is operable for facilitating re-crystallization of the amorphous material and for reducing an oxygen partial pressure.

[c05] 5. The method of claim 1, wherein the biaxially textured surface of the amorphous material comprises a thickness of about 2-20nm.

[c06] 6. The method of claim 1, wherein the biaxially textured surface of the amorphous material comprises a thickness of about 5-10nm.

[c07] 7. The method of claim 1, wherein the amorphous material comprises at least one of: magnesium oxide (MgO), yttria-stabilized zirconia (YSZ), cerium oxide (CeO₂), and yttrium oxide (Y₂O₃).

[c08] 8. The method of claim 1, wherein the substrate is a flexible metal alloy.

[c09] 9. The method of claim 1, wherein the temperature of the substrate is increased from about 22°C to about 600°C during ion beam bombardment.

[c10] 10. The method of claim 1, wherein the temperature of the substrate is increased from about 22°C to no more than 300°C during ion beam bombardment.

[c11] 11. The method of claim 1, wherein the amorphous material is deposited onto the substrate using at least one of: electron beam evaporation, ion sputtering, magnetron sputtering, pulsed laser deposition, and chemical vapor deposition.

[c12] 12. The method of claim 1, further comprising growing a superconducting layer upon the biaxially textured surface of the amorphous material to create a high temperature coated superconductor, wherein the superconducting layer has a J_c of greater than about 100,000 A/cm² at 77 Kelvin and 0 Tesla.

[c13] 13. The method of claim 12, wherein the superconducting layer has an in-plane texture of less than about 20° full-width-at-half-maximum (FWHM).

[c14] 14. The method of claim 12, further comprising depositing at least one intermediate layer between the amorphous material and the superconducting layer.

[c15] 15. The method of claim 14, wherein the intermediate layer comprises at least one of: a homo-epitaxial buffer layer and a hetero-epitaxial buffer layer.

[c16] 16. The method of claim 15, wherein the hetero-epitaxial buffer layer has a good crystal lattice match with a predetermined superconducting material.

[c17] 17. The method of claim 16, wherein the hetero-epitaxial buffer layer comprises cerium oxide (CeO₂).

[c18] 18. The method of claim 12, further comprising utilizing the high temperature coated superconductor in at least one of: a power cable, a power transformer, a power generator, and a power grid.

[c19] 19. The method of claim 18, wherein the power cable comprises a conduit for passage of a cooling fluid, and wherein the high temperature coated superconductor is disposed proximate the conduit.

[c20] 20. The method of claim 19, wherein the power cable comprises at least one of: a power transmission cable and a power distribution cable.

[c21] 21. The method of claim 18, wherein the power transformer comprises one or more windings, wherein at least one winding comprises the high temperature coated superconductor.

[c22] 22. The method of claim 18, wherein the power generator comprises:
a shaft coupled to a rotor comprising at least one electromagnet comprising one or more rotor coils, and
a stator comprising a conductive winding surrounding the rotor,
wherein the conductive winding or at least one of the rotor coils comprises the high temperature coated superconductor.

[c23] 23. The method of claim 18, wherein the power grid comprises:
a power generation station comprising a power generator;
a transmission substation comprising at least one power transformer for receiving power from the power generation station, and for stepping-up voltage for transmission;
at least one power transmission cable for transmitting power from the transmission substation;

a power substation comprising at least one power transformer for receiving power from the power transmission cables, and for stepping-down voltage for distribution; and at least one power distribution cable for distributing power to an end user.

[c24] 24. A method for producing a high-temperature coated superconductor, comprising:

depositing an amorphous buffer film onto a metal alloy substrate;

bombarding a surface-region of the amorphous buffer film with an ion beam at an oblique incident angle of about 0-45° between the ion beam and a surface of the amorphous buffer film while supplying active oxygen to the surface-region of the amorphous buffer film in order to create a biaxially textured surface-region thereon; and

growing a superconducting film on the biaxially textured surface-region of the amorphous buffer film to create a high-temperature coated superconductor.

[c25] 25. The method of claim 24, wherein the active oxygen comprises at least one of: atomic oxygen, oxygen ion, and ozone.

[c26] 26. The method of claim 24, wherein the oxygen ion is a component of the ion beam.

[c27] 27. The method of claim 24, wherein the biaxially textured surface-region of the amorphous buffer film comprises a thickness of about 2-20nm.

[c28] 28. The method of claim 24, wherein the biaxially textured surface-region of the amorphous buffer film comprises a thickness of about 5-10nm.

[c29] 29. The method of claim 24, wherein the amorphous buffer film comprises at least one of: magnesium oxide (MgO), yttria-stabilized zirconia (YSZ), and yttrium oxide (Y₂O₃).

[c30] 30. The method of claim 24, wherein the amorphous buffer film is deposited onto the metal alloy substrate using at least one of: electron beam evaporation, ion sputtering, magnetron sputtering, pulsed laser deposition, and chemical vapor deposition.

[c31] 31. The method of claim 24, wherein the superconducting film has a J_c greater than about 1,000,000 A/cm².

[c32] 32. The method of claim 24, further comprising producing kilometer length tapes, cables or coils comprising the high-temperature coated superconductor.

[c33] 33. The method of claim 24, further comprising depositing at least one intermediate layer between the amorphous buffer film and the superconducting film.

[c34] 34. The method of claim 33, wherein the intermediate layer comprises at least one of: a homoepitaxial buffer layer and a hetero-epitaxial buffer layer.

[c35] 35. The method of claim 34, wherein the hetero-epitaxial buffer layer has a good crystal lattice match with a predetermined superconducting material.

[c36] 36. The method of claim 35, wherein the hetero-epitaxial buffer layer comprises cerium oxide (CeO₂).

[c37] 37. The method of claim 24, further comprising utilizing the high-temperature coated superconductor in at least one of: a power cable, a power transformer, a power generator, and a power grid.

[c38] 38. The method of claim 37, wherein the power cable comprises a conduit for passage of a cooling fluid, and wherein the high-temperature coated superconductor is disposed proximate the conduit.

[c39] 39. The method of claim 38, wherein the power cable comprises at least one of: a power transmission cable and a power distribution cable.

[c40] 40. The method of claim 37, wherein the power transformer comprises one or more windings, wherein at least one winding comprises the high-temperature coated superconductor.

[c41] 41. The method of claim 37, wherein the power generator comprises:
 a shaft coupled to a rotor comprising at least one electromagnet comprising one or more rotor coils, and
 a stator comprising a conductive winding surrounding the rotor,
wherein the conductive winding or at least one of the rotor coils comprises the high-temperature coated superconductor.

[c42] 42. The method of claim 37, wherein the power grid comprises:
 a power generation station comprising a power generator;
 a transmission substation comprising at least one power transformer for receiving power from the power generation station, and for stepping-up voltage for transmission;
 at least one power transmission cable for transmitting power from the transmission substation;
 a power substation comprising at least one power transformer for receiving power from the power transmission cables, and for stepping-down voltage for distribution; and
 at least one power distribution cable for distributing power to an end user.